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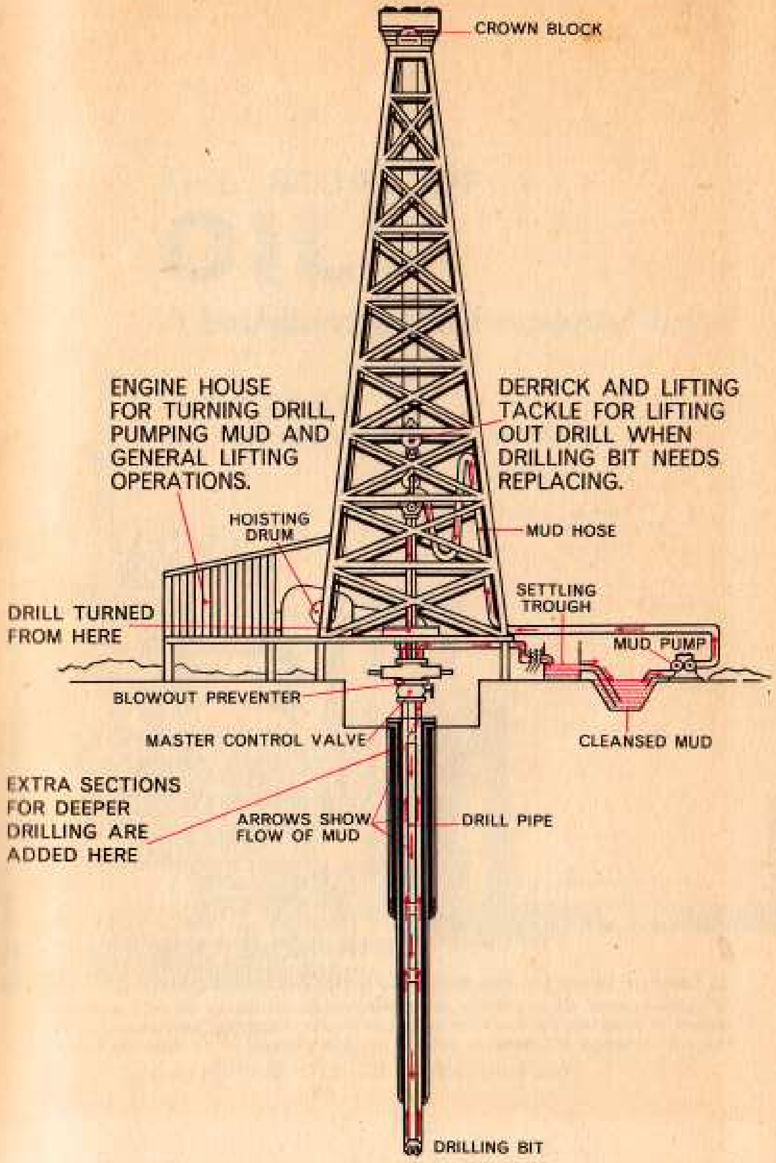
THE STORY OF OIL

A Ladybird 'achievements' book

Series 601

This book tells the story of oil from its formation in pre-historic times to the present day when it is so drastically changing our lives and surroundings. It is a fascinating story which has been clearly and simply told and beautifully illustrated.

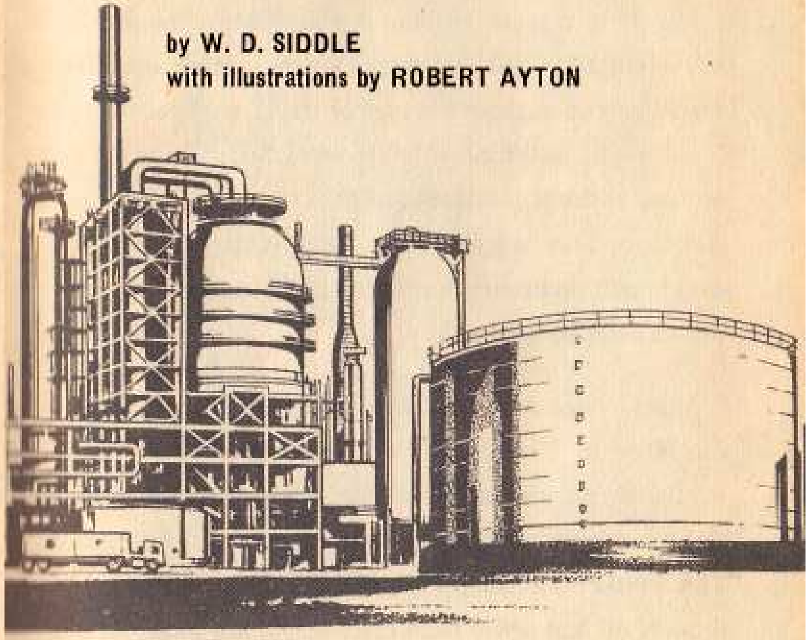
DRILLING



THE STORY OF OIL

A Ladybird 'achievements' book

by W. D. SIDDLE
with illustrations by ROBERT AYTON



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The Importance of Oil

Crude oil, or petroleum, is a black treacly liquid obtained by drilling into the ground in certain parts of the world. It is made up of many different substances such as petrol, paraffin and lubricating oils, all so familiar to us that perhaps we do not always realise how important they are.

However, it is certain that our lives would be drastically changed if oil supplies suddenly dried up. Cars would stay in garages because of the lack of petrol, and buses could not run without diesel fuel. Trains could not run without lubricants to help the wheels go round and aeroplanes would be grounded. Only sailing ships could sail. Without transport to distribute it, food would soon be scarce.

Many other essentials would be missing because the machines to make them would have stopped. There would be no electricity in our homes because power station generators will not turn without lubrication. This would mean no T.V., radio, electric light or electric fires. If oil had never been discovered, life today would probably be very like what it was about one hundred years ago.

Life as it was one hundred years ago

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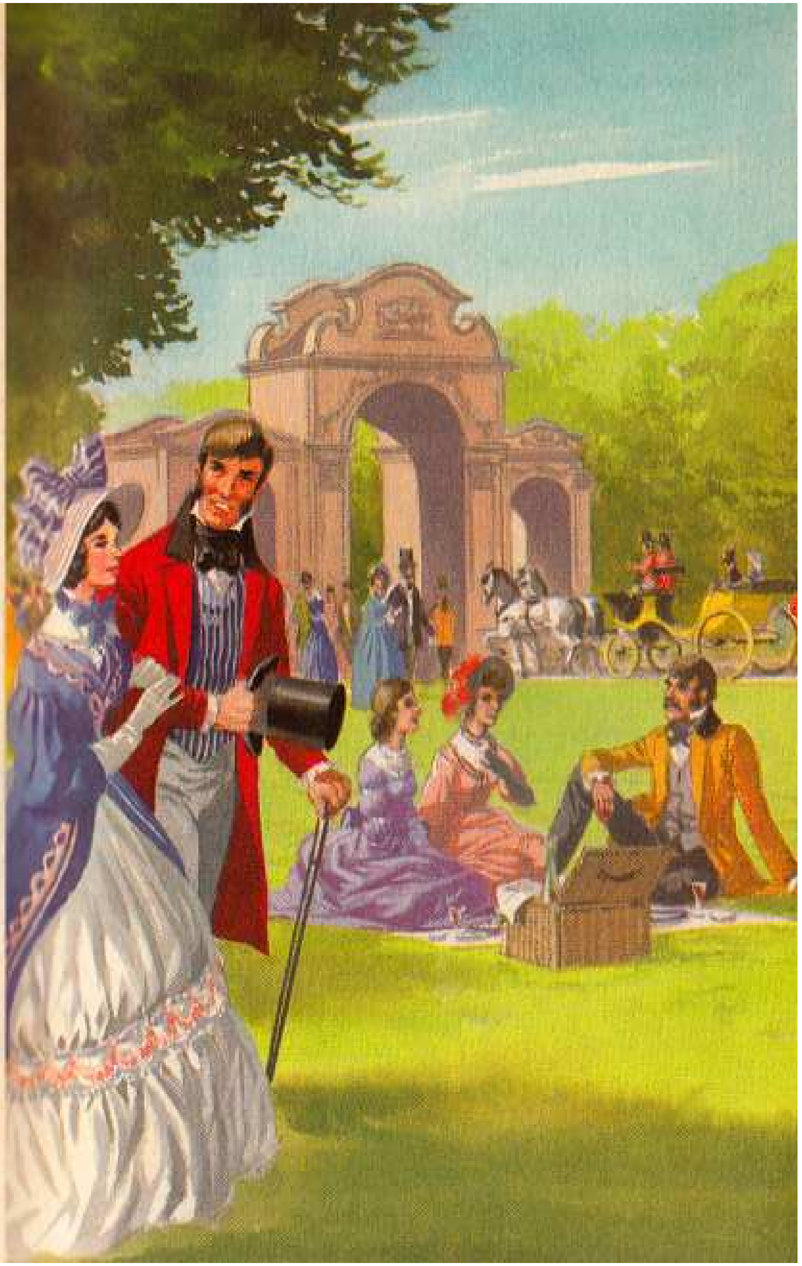


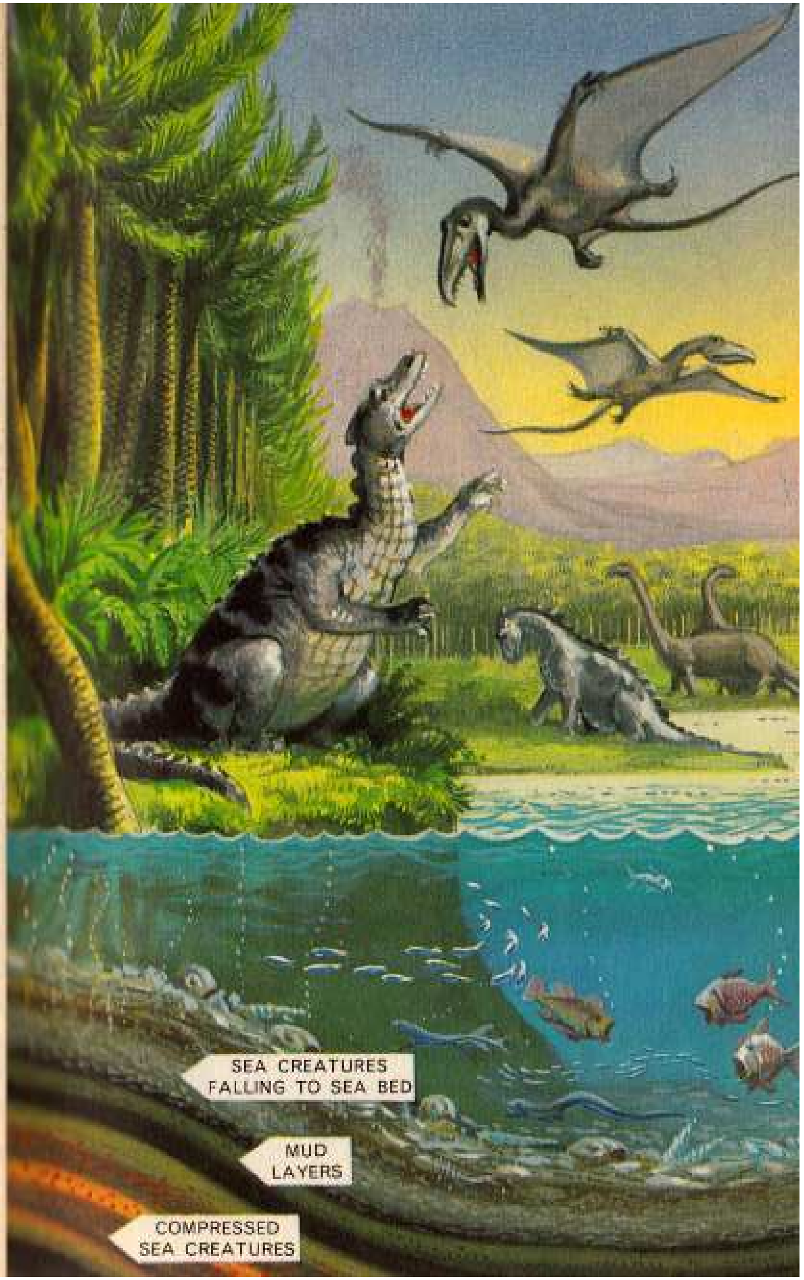
The Formation of the Oilfields

The story of oil began many millions of years ago, at about the time of the large pre-historic animals, when the Earth was covered by many warm, shallow oceans. Countless millions of tiny sea animals lived in these oceans and when they died, the sea animals sank to the ocean bed and decayed into sludge. As time passed, the layers of sludge became very thick, and then were covered by mud. The weight of water and mud pressing down on the sludge changed it into tiny drops of oil. The mud hardened into porous rock, which soaked up the drops of oil like a sponge soaks up water.

Gradually, the oil spread through the rock until it reached a barrier, usually of non-porous rock, which stopped it spreading any further. Because the non-porous rock could not soak up oil, more and more oil collected in the porous rock until what we now call an oilfield was formed.

The whole process of forming an oilfield takes many millions of years. Oilfields may be large or small, near the surface of the Earth or, due to strata changes, very far below it. They may be found anywhere in the world where the right kind of rocks exist, but many of them are too small to make the oil worth extracting.

Over millions of years, the small sea creatures sank to the bottom and were compressed



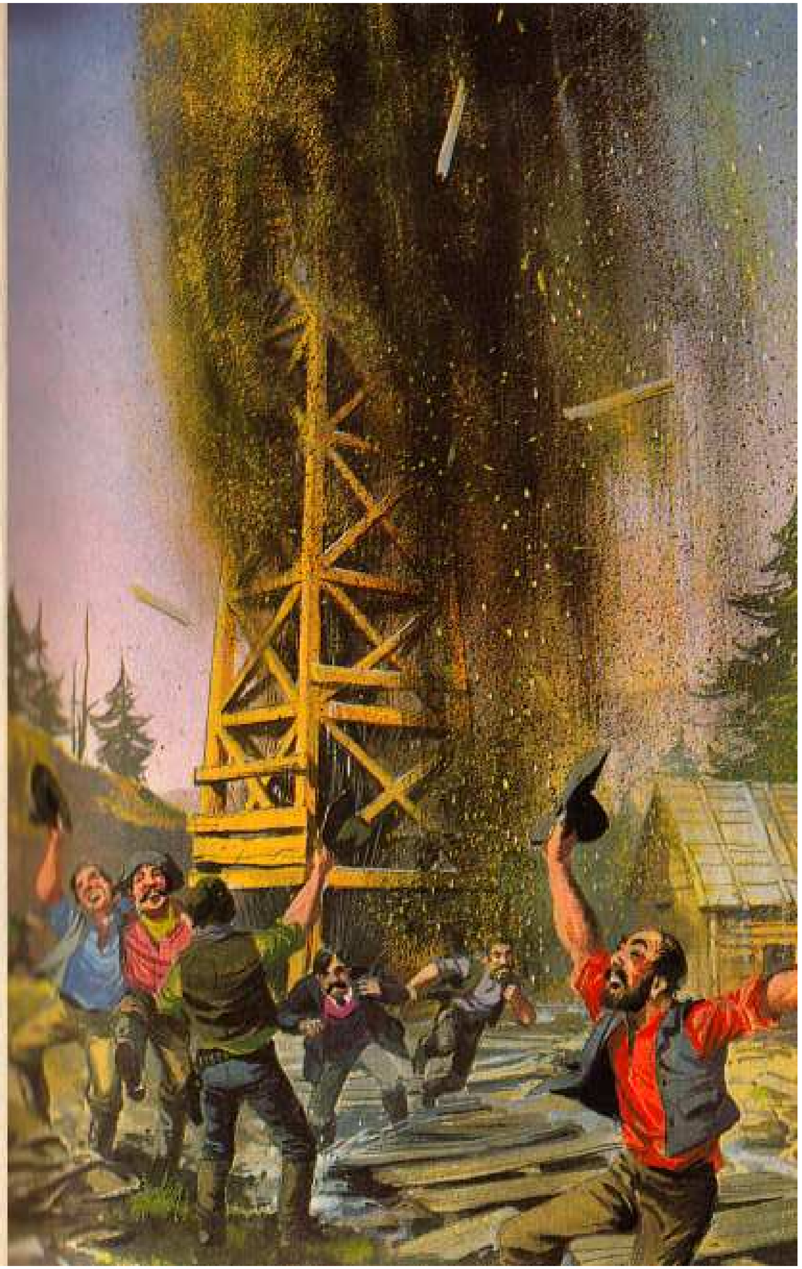
Man Drills for Oil

One of the earliest references to the use of oil is in the Bible. The pitch which was used to caulk Moses' cradle was probably a very thick, crude oil, and it is known that the ancient Egyptians used oil for various purposes. Yet it was not until the middle of the last century that anyone really understood the value of oil.

Oil frequently seeps to the surface and people in Pennsylvania, U.S.A. collected and burned it in oil lamps, or put it in bottles to sell as medicine.

Certain business men thought that if enough oil could be collected, it could be sold all over the U.S.A. In 1858, the Seneca Oil Company sent Edwin Drake to drill for oil at Titusville. Drilling seemed the sensible way to get at the vast quantities of oil that the company believed must lie near the surface. Drake used the same methods as salt miners in the area. His men started drilling in August, 1859 and soon achieved a rate of three feet a day.

By Saturday, 27th August, the drill had penetrated sixty-nine feet into the ground. Just before the end of the day, the drill suddenly dropped six inches, so work ended for the day. Next morning, the men saw oil floating on top of the water inside the drilling pipe. This well did not 'gush' as so often happened from early wells.



An early oil 'gusher'

The Early 'Oil Rush'

Drake's success at Titusville started an 'oil rush'. Operators, some of them with little or no knowledge of prospecting, obtained concessions and drilling derricks sprang up in a mass all over the area.

Many of these operators did not realize that oil could be found at varying depths, so, bitterly disappointed they stopped drilling at exactly sixty-nine feet, the depth of Drake's well and moved off to try elsewhere, provided money could be found to finance a new venture.

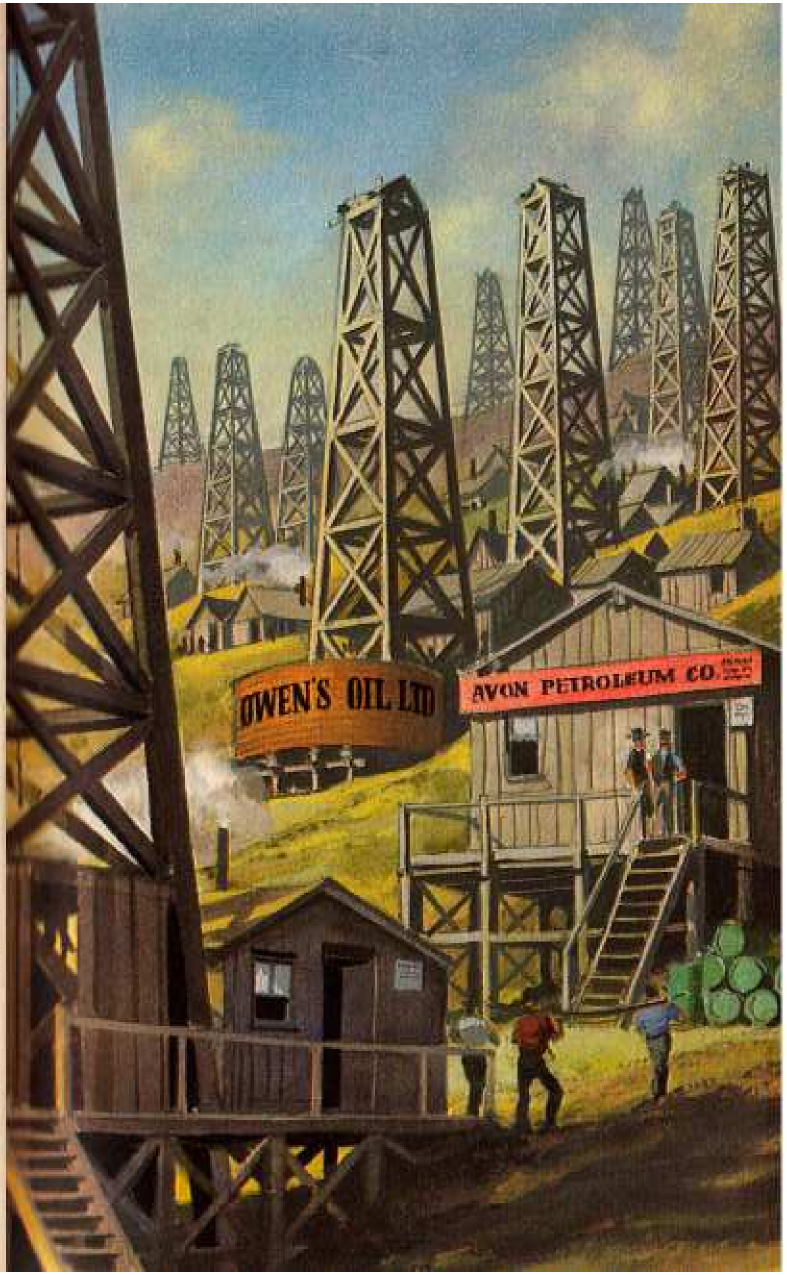
Hundreds of holes were drilled from which no oil came; from many, oil gushed out unexpectedly, often with great force, and vast quantities ran to waste before the flow could be controlled.

Within a year of Drake's discovery there were more than seventy productive wells. By the end of 1864 Oil Creek, as the area became known, was producing two hundred thousand gallons of crude oil every day.

After oil was first struck in 1859, the search widened and in 1862 oil was found in Colorado and another oil rush started. The majority of the new holes were dry because operators had no way of knowing where the best places were to drill.

The modern oil explorers have scientific methods to tell them where to drill and their chances of striking oil are much greater.

An early oilfield



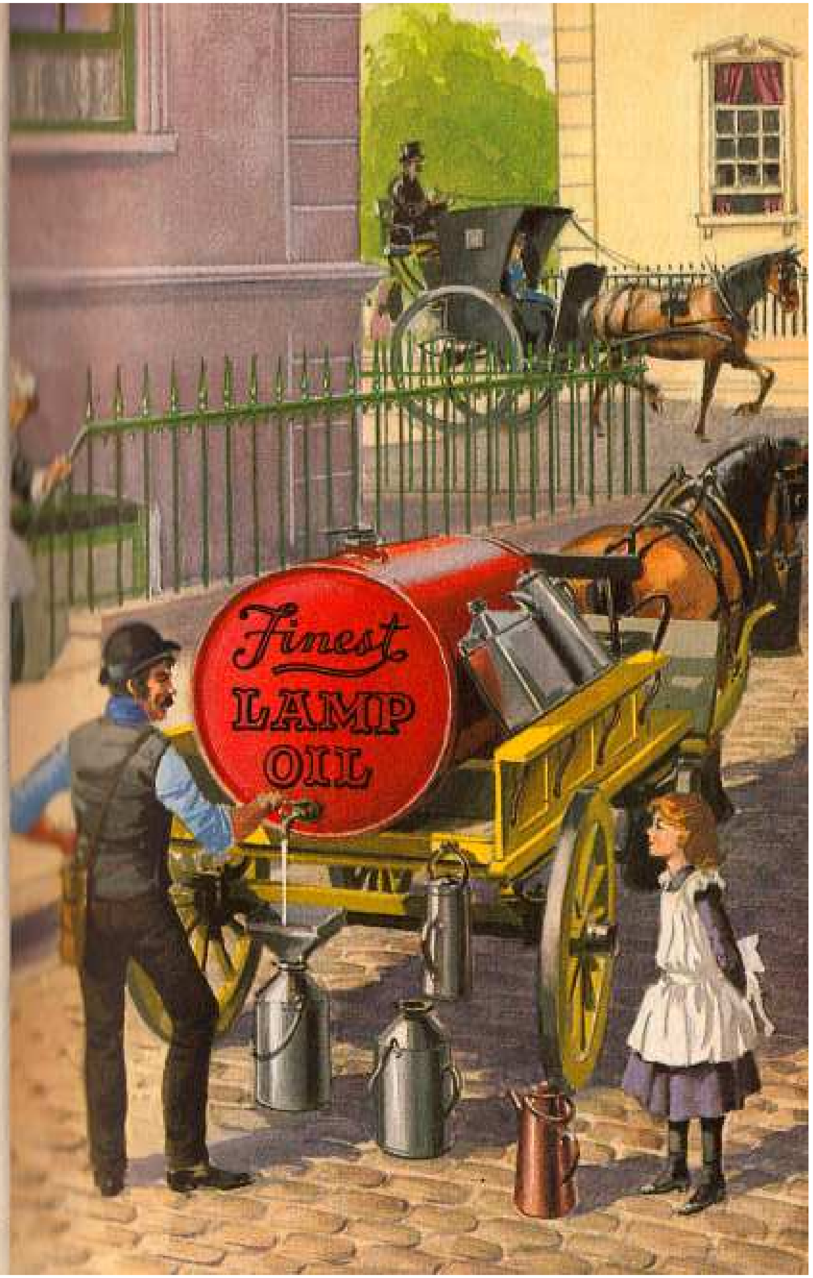
The First Refineries

The next stage was to build refineries in which the different substances of the crude oil could be separated from each other. The principal process, which is still used today, was distillation. The oil is heated strongly in a special furnace, and the vapours produced condense at different temperatures and so can be easily separated.

For many years the chief product from the early refineries was lamp oil, so called because it was burned in oil lamps. Great Britain was among the countries to which lamp oil was exported. Enterprising salesmen toured the streets of London, and other large cities, in horse drawn carts, carrying tanks of oil which they sold by the gallon. By 1900, lamp oil was so popular that over one hundred million gallons of it were being sold in Great Britain alone every year.

Another, more inflammable, liquid was produced by distillation of crude oil. Sometimes separation of this liquid from lamp oil was not complete, and the oil exploded when it was lighted in a lamp. There appeared to be no commercial use for this liquid, and the usual way of getting rid of it was to pour it into open pits and burn it. This liquid was petrol, for which there was then no use!

Delivery of oil by horse and cart



The Coming of the Motor Car

In 1885, a petrol engine was used for the first time to propel a road vehicle. This event proved of great significance to the oil industry because this vehicle was the forerunner of the motor car. Soon a number of manufacturers were building cars and it seemed that there was a use for the waste product that had previously been burned in pits. However, it was not until Henry Ford began the mass production of cars that car owning came within the reach of vast numbers of people. As car production increased, more and more petrol had to be produced. Crude oil contains only a certain proportion of petrol and, in those days, the only way to get more petrol was to refine more crude oil. This in turn produced more of the other substances of which crude oil is composed. One of these was fuel oil for which there was little demand, so the surplus had to be burned just as petrol had been burned. The oil industry had not reached the stage where it could find a use for everything produced at a refinery.

The advent of the motor car made petrol the main product of the oil industry. At the same time, the increasing popularity of gas lighting and, later, of electric light steadily reduced the need for lamp oil and made oil lamps almost obsolete.

An early motorcar

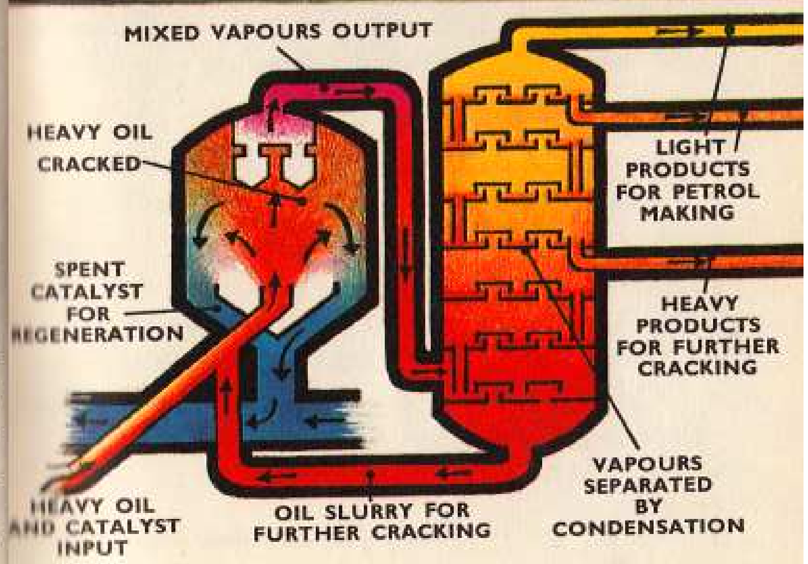
Improving the Quality

Crude oil obtained from drilling contains only a small proportion of petrol. It also contains a less inflammable liquid called *heavy oil*, or *fuel oil*. This heavy oil was wasted after distillation, as there was then little use for it. Obtaining petrol by distillation was therefore an expensive method. In addition, the improved design of engines meant that a better quality petrol was needed as motoring became more popular. The problems of price and quality were solved by a process called 'thermal cracking', which turned heavy oil into petrol of good quality.

In thermal cracking, heavy oil is heated to a very high temperature under great pressure. The oil is 'cracked', to form some of the products from which petrol is made.

In a modern oil refinery, heavy oil is cracked by means of a chemical called a 'catalyst'. The catalyst changes the oil much more rapidly and easily than heat alone and is not changed itself. This means that it can be used many times.

'Catalytic cracking' produces better quality petrol than thermal cracking did, but petrol today has to be so much better than it was thirty years ago that other processes are also necessary to get the required quality.



A modern 'cat-cracker' and how it works

Supplying more—and better—Petrol

Refining processes produce petrol of very high quality, but certain properties can be made even better by adding small quantities of chemicals, called 'additives' to the petrol. This is done by the petrol manufacturer.

One of the earliest additives was tetra-ethyl-lead, or T.E.L. When this is added to petrol, it improves the resistance of the petrol to 'knocking'. Knocking is a banging noise due to incorrect burning of the petrol and indicates that the petrol is not suitable for the engine. It also means that the engine is not operating efficiently, and power is being wasted.

T.E.L. is very poisonous, and there was considerable argument before permission to add it to petrol was granted in 1928. Now, there is controversy whether lead compounds emitted in exhaust gases are harmful to health.

Methods of selling petrol have also changed with the increasing demand. In the early days, motorists had to buy their petrol in cans from chemists' or ironmongers' shops. Then the hand-operated kerbside pump appeared in 1919. Later, the pumps were sited away from the kerb side, and then became electrically operated. The modern service station, in which you may serve yourself from push-button petrol pumps, has been developed from these early beginnings.

An early hand-operated petrol pump

The increasing need for Oil

Cars became so popular that, by 1930, over one million of them were registered in this country and by 1938, there were more than two million. Other forms of transport such as buses, lorries, and aeroplanes also used petrol, and as they became more numerous, so the total amount of petrol they burned increased. Petrol was not the only fuel used, however. Public service vehicles and transport fleets can also be fitted with diesel engines which burn diesel oil, and there was a significant increase in the number of Diesel Engined Road Vehicles during the 1930's. The name DERV for diesel fuel comes from the initials. Fuel oil was used in oil-burning ships and the R.M.S. Queen Mary, then the biggest ship in the world, was designed and built as an oil-fired vessel.

In the eighty years between the drilling of the first oil well and the outbreak of war in 1939, the story of oil had two distinct parts. The first use was for lamp oil, and from 1910 onwards for petrol. Many developments in manufacturing and selling had helped to create the petrol era, and in 1939 more petrol was sold than all other petroleum products put together. However, signs of more widespread use of other products were already apparent.

The oil-burning Queen Mary arrives at New York

The arrival of the Jet Engine

The war in 1939–45 stopped the expansion in the use of oil. Petrol, which had to be imported at great risk to the tanker crews, was strictly rationed. Only essential services like the Forces and Civil Defence could get adequate supplies. The use of other petroleum products was similarly restricted.

One very important happening during the war was the rapid development of the jet engine. The ordinary piston-type petrol engine had been developed to a high stage of efficiency, but some new kind of engine was necessary to make planes go even higher and faster. The jet engine seemed to be what was needed but, although it had been invented some years before the war, it had still not reached the stage where it could be used in an aircraft. Its development had to be speeded up.

This was done so effectively that the first British operational jet aircraft, the twin engined Gloster Meteor, was in service with the R.A.F. before the end of the war. The huge Boeings and Jumbo jets of today are the natural successors to the Meteor.

Many modern jet aircraft use kerosene (paraffin) as fuel. This kerosene is similar to the lamp oil which started the story of oil, although it is much more highly refined.

An artist's impression of a supersonic 'Concord'-type jet airliner, with hinged nose for landing and taking-off

Modern refining and distribution

Since World War II, there have been vast changes in almost all the uses of oil. Methods of distribution have changed completely. Instead of importing finished products that have been refined at the oil fields, we have built refineries in Britain and now import crude oil and refine it ourselves. These refineries are on the coast, where the big tankers can berth easily and discharge their cargoes. More oil is being used, so we need bigger and bigger tankers to carry it. The biggest tanker in 1945 was twenty-four thousand tons. By 1967, tankers of two hundred and fifty thousand tons were being built. The largest tanker now in service is over three hundred thousand tons, and tankers of up to one million tons are being planned.

Refined products are now distributed by smaller tankers and by road and rail. Long, high speed trains of tank cars, bearing the insignia of the major oil companies, are a familiar sight. Road tankers which can carry loads of up to thirty-two tons, deliver regularly to factories and offices.

The newest form of distribution is the pipeline. The refinery is connected by underground pipes to large storage depots, sometimes hundreds of miles away. Petrol, paraffin and other products are pumped through these pipes into storage tanks. Pipelines cannot be seen, and once they have been buried they cause no inconvenience.

A modern refinery and road-tanker

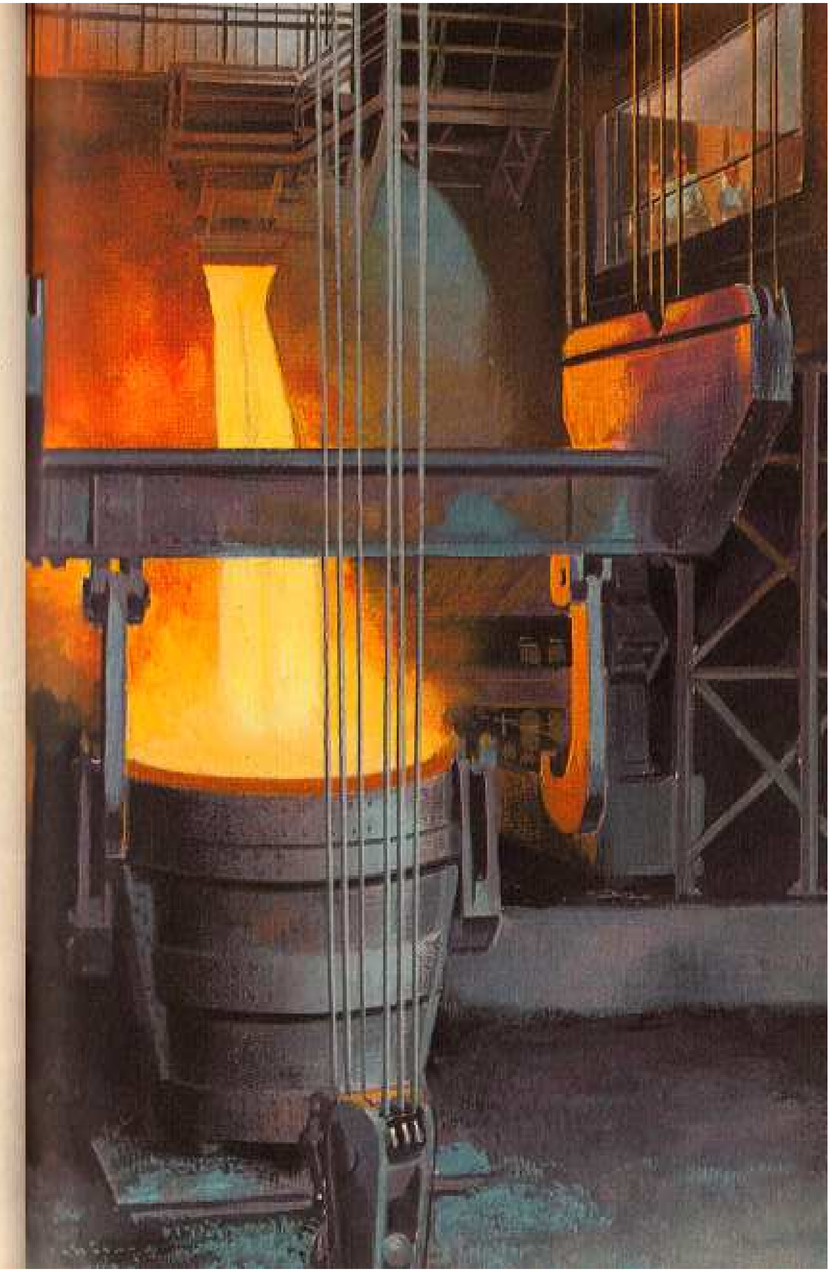
Fuel Oil

The biggest change in the use of oil since the war has been the increased consumption of fuel oil. As industry changed from making military weapons to making things needed in peace time, fuel oil became important as a source of energy. There was not enough coal, the traditional source of energy, and industry had to use fuel oil instead. Many different branches of industry converted their coal-fired plant to oil-firing. New factories were built with oil-fired furnaces and boilers.

Oil-fired equipment can be operated automatically, and so helps to save labour. A properly maintained and operated oil-burning installation makes very little smoke and helps to keep the atmosphere clean. These are some of the reasons why fuel oil has become an important fuel for industry.

Among the many different kinds of furnaces using fuel oil are open-hearth steel furnaces, and furnaces for firing the beautiful china tea sets which earn so much as exports. Heat from burning oil helps to prepare the materials from which glass is made. Even the bricks from which our houses are built are frequently baked in oil-fired kilns.

In the days when petrol was the chief product of an oil refinery, fuel oil was almost a waste product. Now, it is a very important one.



Molten steel pours from an oil-fired furnace

More uses of Fuel Oil

Another important use of fuel oil is for steam raising. The principle is exactly the same in industry as that used when boiling a kettle. Boiling water turns to steam, which can then be forced along pipes to wherever it is needed. In industry, steam raising is carried out in large boilers under carefully controlled conditions so that the amount of steam, its temperature and its pressure are known. Steam must be produced as economically as possible to ensure that no fuel is wasted. Automatically controlled oil burners shut off, and start up, exactly when required, so steam is produced only when it is needed.

There are three principal uses of steam in industry. One is for heating large factories and offices. One or two large boilers, generally situated in the basement, provide enough hot water or steam for the entire building.

Another use is for manufacturing processes, a good example being the tyre industry, in which steam-heated moulds produce the tread patterns on tyres. The third use of steam is as a source of power for driving steam engines, or steam turbines. Steam turbines are one of the major power units in electricity generating stations.

The boiler-room of a large building

Fuel Oil in the Home

While oil as a fuel for large boilers has been known for many years, it is only comparatively recently that it has been used as a fuel for the small boilers in domestic central heating systems. Until about fifteen years ago, few British houses had any form of central heating and these were often the large, luxurious mansions. Now, central heating can be installed in even the most modest of homes, and there is fierce competition among the coal, gas, electricity and oil industries to provide the fuel. Each has its advantages and disadvantages. Oil is cheaper to run than gas or electricity, but needs a storage tank and a more complicated boiler. This handicap is being over-come on many new estates by building one or two large underground storage tanks to serve the whole estate. Oil is piped from the central storage tank to a separate boiler in each house.

The grade of oil used for central heating depends on the type of burner fitted to the boiler, and this depends to some extent on the size of the boiler. Heavy fuel oils are used for the biggest boilers, and lighter oils, called heating oils, are used for small boilers.

Installing an underground oil storage tank

Oil and the production of Gas and Electricity

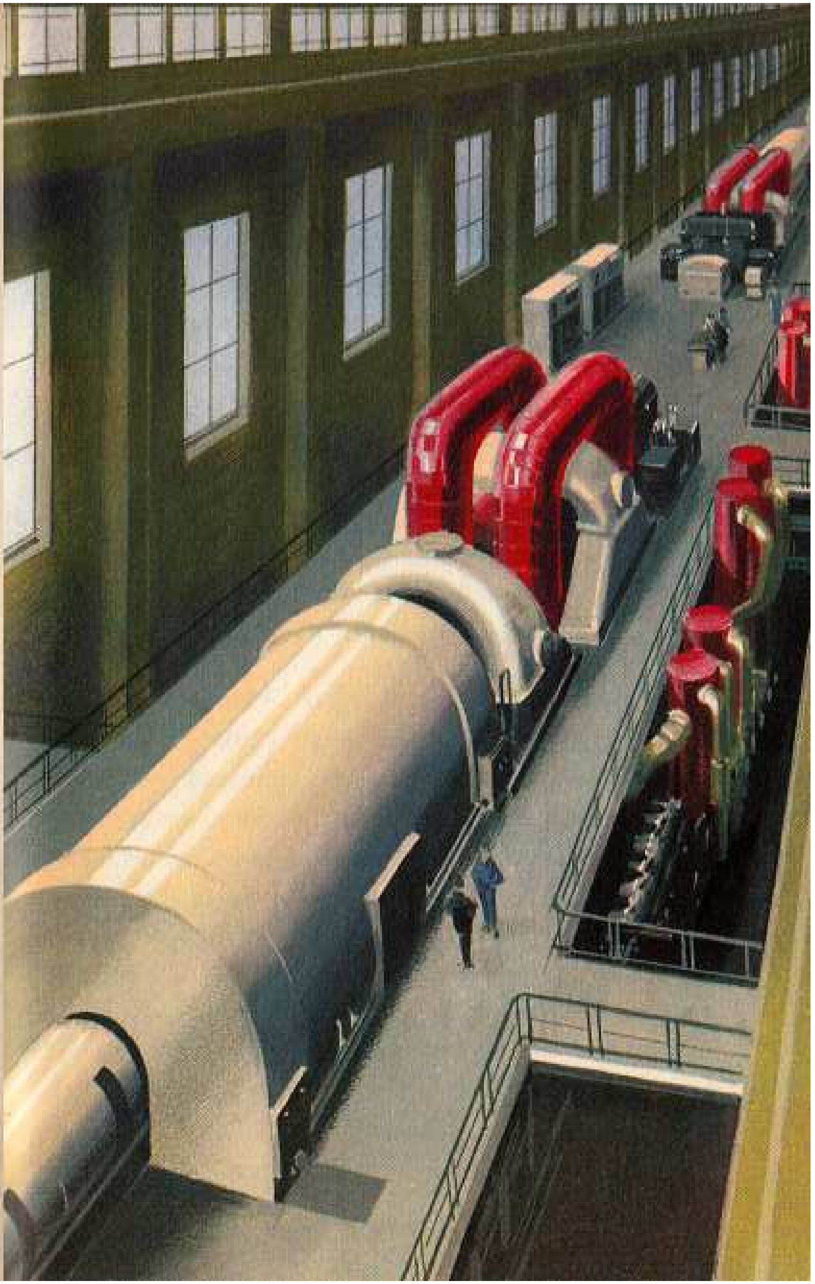
Oil, coal and atomic power are *primary* sources of energy. Electricity, which must be generated from a primary source, is a *secondary* source of energy. Natural gas is a *primary* source, town gas is a *secondary* source. Although oil competes with gas and electricity in many ways, it also helps to produce them.

There are a number of industrial processes to convert oil into town gas. Many special plants were built for such conversions. With the increasing use of North Sea gas, many of these plants have been closed, and the use of oil for manufacture of town gas is declining.

Electricity is produced by generators which require some form of power to turn them. This power may come from diesel engines, which burn diesel oil, but much more often it comes from steam turbines. Some of the new power stations have oil-fired boilers to provide steam for the turbines.

Since the war, fuel oil has superseded petrol as the principal product of the oil industry. In 1939, only seven gallons of fuel oil were sold for every fifty-five of petrol. By 1970, 38 gallons in every hundred were fuel oil, and only fourteen in a hundred were petrol. Even so, nearly three times as much petrol was sold in 1970 as in 1939.

The turbine hall of a power station



The importance of Diesel Oil

While the petrol engine so far has no serious competitors as the power unit for motor cars, the diesel engine is much more popular for larger vehicles. Our city bus fleets, like London's, are diesel powered. Diesel engined trucks and coaches are a familiar sight on our roads. On farms, diesel engines have almost completely eliminated all other forms of power for tractors, combine harvesters, balers and other machinery.

Since the war, the proportion of all these kinds of vehicles using diesel engines instead of petrol engines has increased considerably until, in some instances, petrol engines are very rare.

However, the most spectacular increase in the use of diesel engines is on the railways. Under its modernisation plans, British Rail has replaced all steam locomotives with diesel or electric locomotives. Already, most of our main line expresses are hauled by powerful diesels, and diesel rail-cars operate many local services.

Diesel engines work in a different way from petrol engines. They need no sparking plugs, the diesel oil they burn does not evaporate as easily as petrol, and they can be made larger, more powerful and more robust than petrol engines. The diesel engine is often the only practicable power unit that can be obtained.

A diesel-powered express and rail-car

Uses of Oil on the Farm

One of the most highly mechanised industries in Britain is agriculture. The number of tractors per acre is greater in this country than in any other country in the world; there is one tractor for every thirty-nine acres of agricultural land. All these tractors must have fuels and lubricants to make them work, but the farmer needs many other oil products to help him with his daily tasks. Fuel oil heats his grass and grain driers. Synthetic rubber, produced from oil, is used as a lining for small reservoirs to prevent water from seeping away into the soil. Oil-based rust-preventives keep his implements bright and shining when they are stored for the winter. Many of the insecticides and weed killers he uses are powders dissolved in petroleum solvents so that they can be sprayed more easily. Even milking machines are supplied with special lubricants to ensure that they work quietly and effectively.

The farmer is not completely dependent on oil. Without it, he could still plough his land and sow his crops, but horses cannot work as hard or as long as tractors. Food could still be grown, but there would be much less of it.

Modern mechanised farming

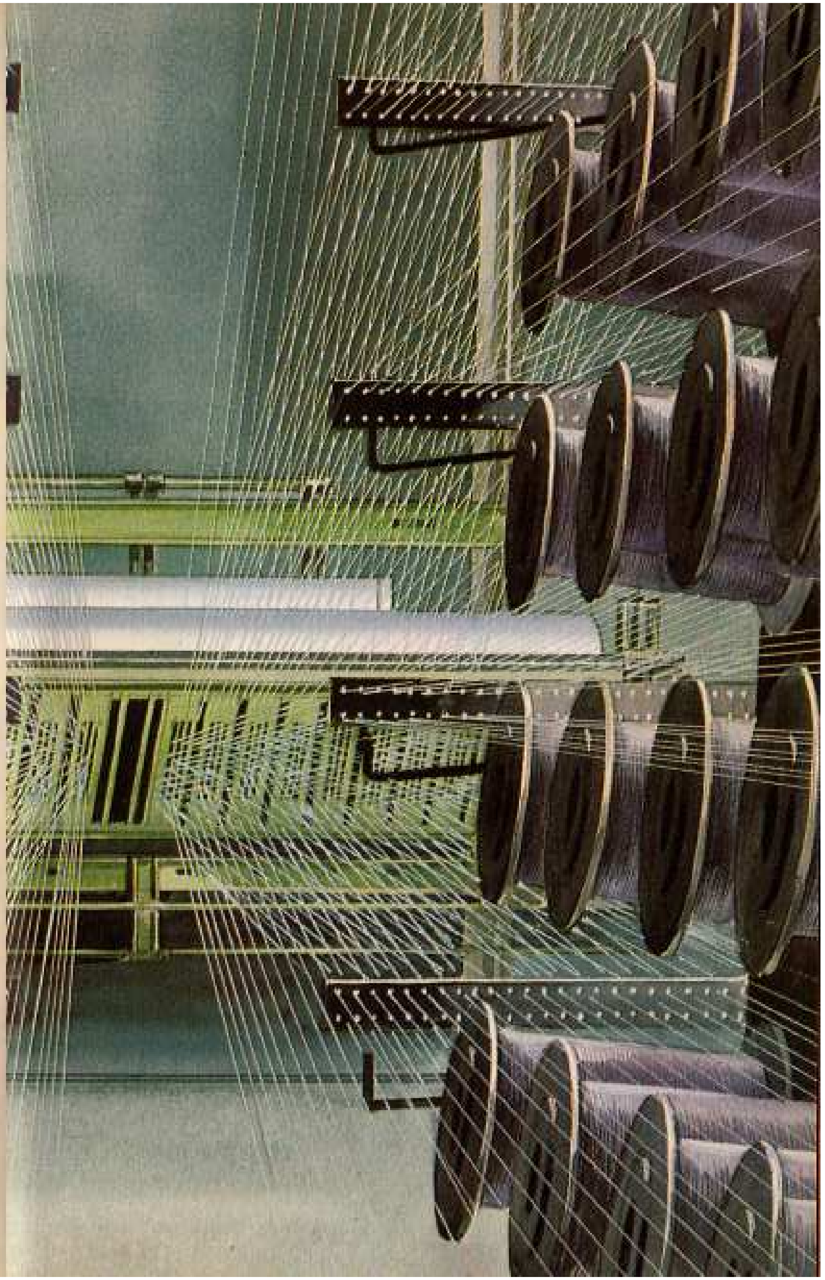
New uses for Oil

The rapid increase in the use of fuel oil to produce energy is one of the two most important developments in the story of oil in the last twenty years. The other is the establishment of a completely new industry called the petrochemicals industry.

Petrochemicals are substances made from petroleum products by chemical processes. The petroleum products used are called chemical feedstocks. For example, ethylene is a gas which can be produced by refining crude oil. Chemical processing turns ethylene into polyethylene in the form of granules or powder. These granules are then used to manufacture polythene goods like kitchen utensils.

The earliest petrochemicals were made in the 1930's. In U.S.A., synthetic rubber was made in the laboratory from a petroleum feedstock. Later, during the war, a shortage of natural rubber meant that more synthetic rubber had to be produced. In this country, a shortage of the fats from which soap is made led to the development of detergents.

From small beginnings, the petrochemical industry has grown until more than half of all organic chemicals manufactured in this country have a petroleum product as their starting point. This growth is largely due to the increase in the amount of crude oil now refined, making available a plentiful supply of suitable chemical feedstocks.



Spinning fibres made from petroleum products

More man-made materials

Some chemical feedstocks are by-products of oil refining and are produced while crude oil is being processed to obtain the more usual products. Other feedstocks require special plants to obtain the quantities needed. The chemical factories that turn the feedstocks into petrochemicals are frequently built next door to oil refineries so that transfers of feedstock from one to the other can be made easily. A short pipeline is often all that is needed.

Petrochemicals are used in the manufacture of a very large number of domestic, industrial and commercial articles such as transistor radio cases, long playing records, electric insulation and cups and saucers. Most of us wear some articles made from man-made fibres like nylon and Terylene. Washing powders and detergents help to keep clothes clean. A car, if it has inner tubes in its tyres at all, probably has synthetic rubber ones. The same synthetic rubber, in the form of thin sheets, makes a good waterproof seal for the roofs of buildings.

In the years to come, more and more of the clothes we wear, and the things we use, will come from petrochemicals.

Some of the uses of petrochemicals

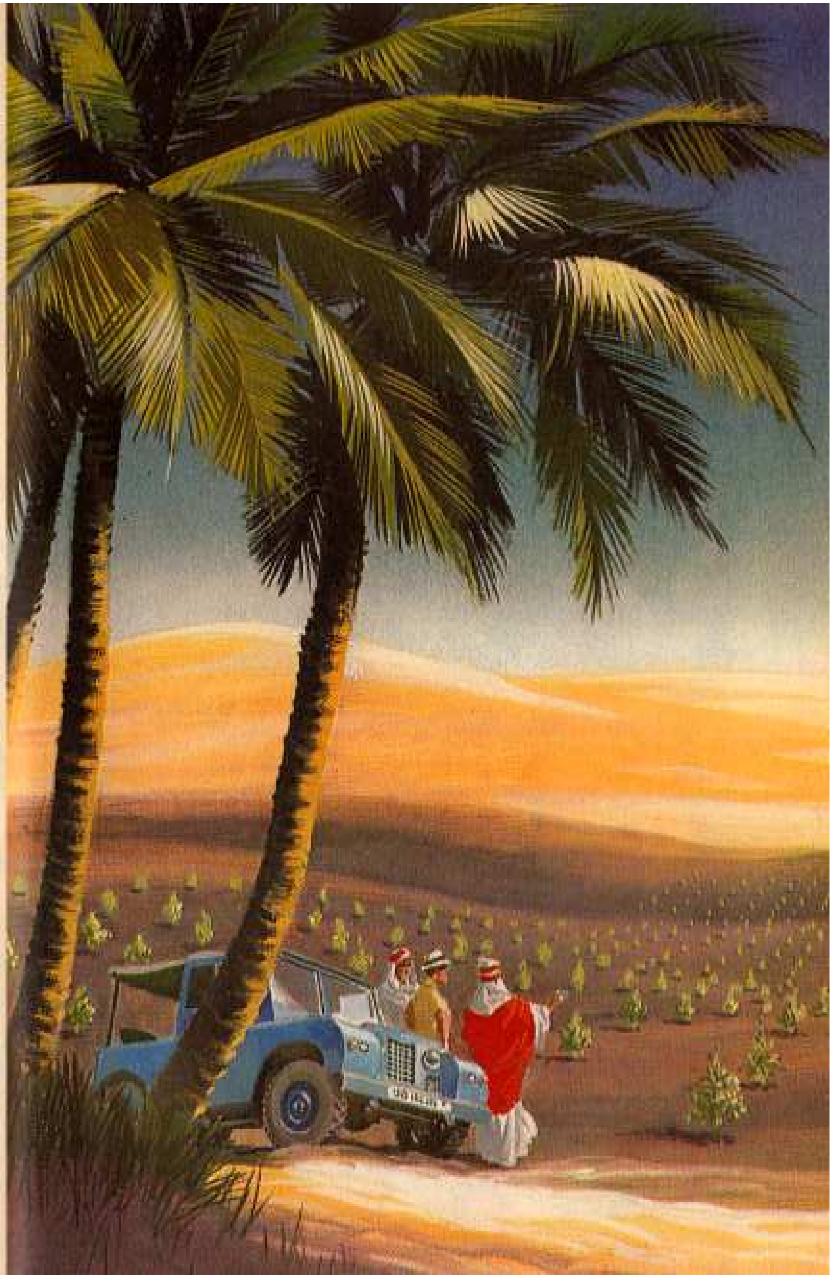
Some future possibilities

Petrochemicals resulted from research in the oil industry. Research aims at making good products better, discovering new uses for old products, and finding new products. In some ways, research can be considered as a look into the future, because many of the things found now by research may not be fully developed for several years.

The fight against food shortages provides a good example of what oil research can achieve. Food shortages are due to many things, including lack of rainfall or land that is not fertile. People have said, 'If only we could grow plants in the desert'. Now, they can. Research has shown that if a certain kind of oil is sprayed onto sand, the oil will reduce evaporation, bind the sand together, and provide a firm base for plants. Trees planted in the Libyan desert five years ago are now over seven feet high. One day, edible crops will be planted and the deserts may become great food producing regions.

In wetter, cooler climates, a different kind of oil can be sprayed onto fertile land in which crops like lettuce, beans and peas are growing. This oil helps the soil to remain warm and moist; and makes the crops grow bigger and more quickly.

Oil helps to make the desert fertile



Helping to solve the World food shortage

Growing more food in the traditional ways may not cure the world food shortage, because there could still be a lack of protein-containing food. The human body must have proteins to build and keep it strong, but most plants and vegetables do not contain either enough, or the right kind, of protein. Meat, fish and eggs contain ample protein, but these foods are not easily obtained by people in under-developed countries. Also the population of the world may be doubled by the year 2000. So some alternative method of producing proteins in sufficient quantities must be found. Oil research may have found one way of helping.

Certain kinds of micro-organisms, like yeast, feed on petroleum products. While the organisms are growing, they produce proteins which are very like those produced by natural processes. Many more experiments are necessary before these proteins from oil can be produced for human consumption, but they are being fed to animals. If the experiments are successful, only forty million tons of petroleum every year could cure the protein shortage of millions of people, and this is only a small fraction of the annual output of petroleum.

Research workers in a laboratory

The constant search for Oil

The element of luck was everything to the early prospector. His chances of 'striking it rich' were very remote and even today the element of luck is still needed, although the chances of finding oil are much less remote due to the highly scientific preliminary ground searches.

Only the sinking of a test drill on sites previously and carefully explored by scientists can prove the presence of oil in commercial quantities.

These sites seem most often to be tucked away in the most inaccessible places all over the world. Roads have to be built to carry the heavy equipment and materials to set up a test rig. Airstrips have to be laid to bring in experts by plane. The cost is enormous; a test drilling on one of these sites may cost as much as four hundred thousand pounds and on an average only one test in ten may prove successful.

Geologists' surveys have also sent these exploratory rigs out to sea to search beneath the sea bed. This is a mammoth undertaking. A vast platform is built on piers to carry the drilling rig, a helicopter platform constructed for air communications and living accommodation provided. On this structure the oilmen must live until the search for oil proves successful or otherwise.

A sea rig

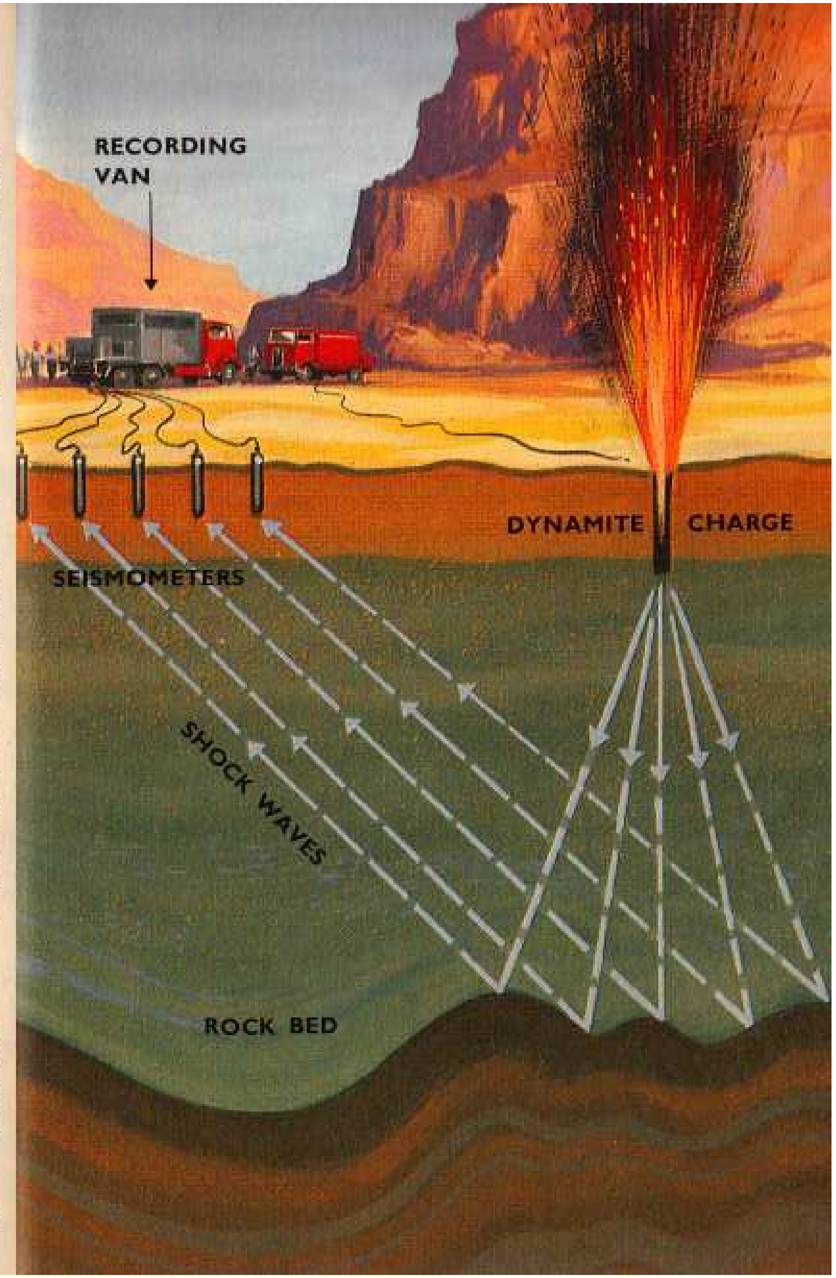
Science helps in the search for Oil

The search for oil goes on in many parts of the world. The large oil companies spend many millions of pounds each year using highly scientific methods of detection. Skilled geologists roam the mountains, deserts, jungles and swamps, patiently studying and analysing specimens of rock chipped off with their hammers, examining sample borings and making maps in order to gain a picture of the rock formation beneath the earth's surface.

If the geologist's report shows promise, the geophysicists move in with highly sensitive instruments. Aerial survey and the use of a *magnetometer*, an instrument which detects slight variations in the earth's magnetic field, help to give a clearer picture of the rock strata and the possibility of oil. The seismometer goes even further towards clarifying the picture; this instrument is used in the study of earthquakes. In the search for oil the scientists create a miniature earthquake by setting off an explosive charge buried in the earth. Shock waves travel downwards through rock strata of varying density, and each stratum bounces back an echo which is picked up by a series of seismometers buried some distance away.

These instruments, together with a seismograph, record the returning shock waves in the form of jagged or wavy lines on paper strips, thus indicating the profile of rock layers and, from this, the geologist can determine the possibility of oil content.

Recording shock-waves in the search for oil

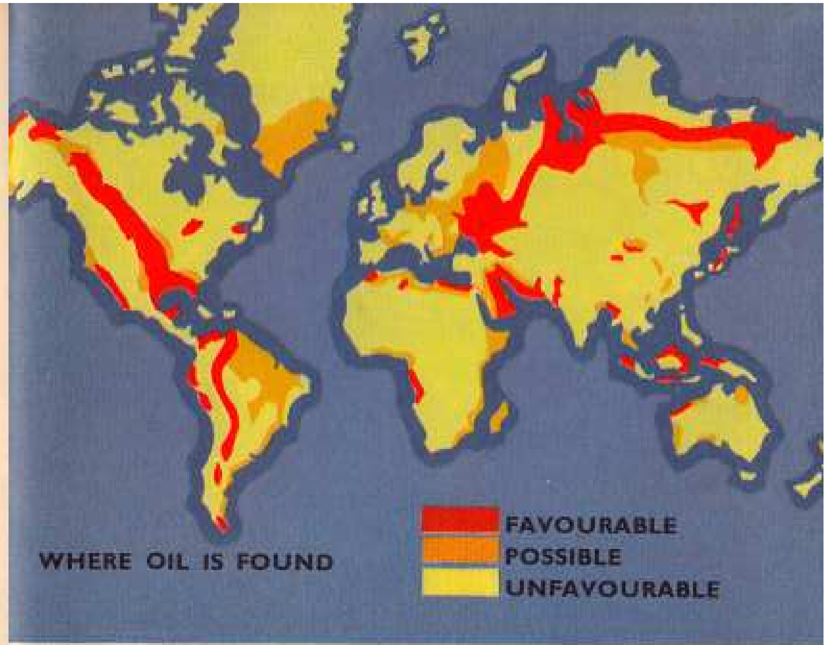


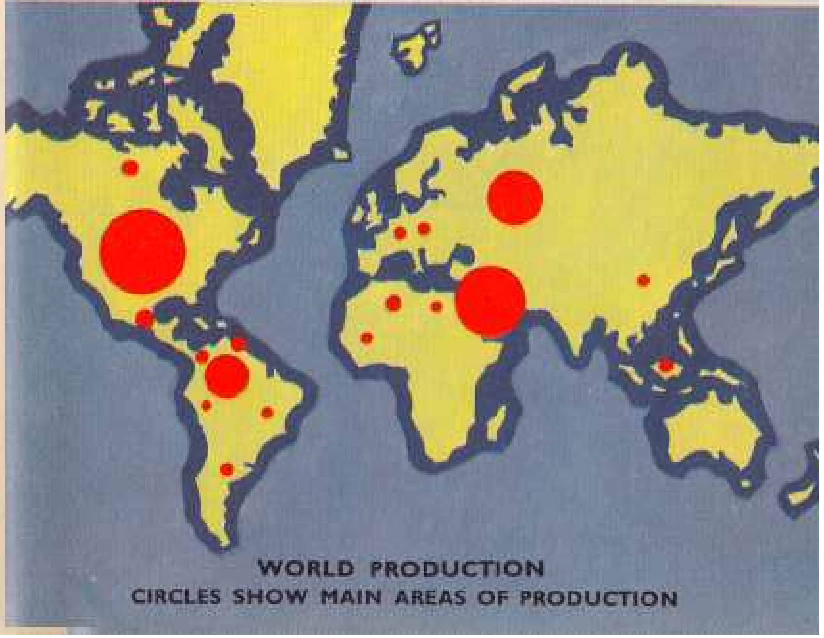
How much Oil is there?

The story of oil shows how oil serves mankind in many different ways, and how much poorer we all would be without it. Will we ever be without it? Will all the oil be used up one day? This depends on whether the oil industry can discover new sources of oil faster than the old ones are used up. Since the world will need as much oil in the next ten years as it has used in the last 100, the rate of discovery will have to be increased to match. Although finding and producing oil gets more difficult each year, new discoveries are still being made in places as far apart as the North Sea and Alaska.

Besides conventional oil fields, immense deposits exist of oil-bearing tar sands and oil shales from which oil may be extracted when suitable processes have been perfected. The Athabasca Tar Sands in Canada contain more oil than the total, readily obtainable quantities already discovered in conventional oil fields.

There is a race between the explorers and producers, and the consumers. Many experts predict that the consumers will win, and that there will be a world wide shortage of oil by the year 2000. Whatever the outcome, the next 30 years in the story of oil will be just as exciting as the first 100.





Oil-bearing areas and main areas of production